AN ELECTRODYNAMIC METHOD OF MEASURING ABSOLUTE MAGNETIC SUSCEPTIBILITIES OF SINGLE CRYSTALS

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In a short communication, Ghosh (1961) has described an electrodynamic method for compensation of magnetic force in a Curie-type magnetic balance. In Ghosh's method, the magnetic sample in powder form packed in a spherical glass ampoule is placed inside a current carrying coil and are together rigidly attached at one end of a horizontal Curie-balance arm (Dutta Roy, 1955) The method was immediately afterwards modified by the present authors to suit single crystals as described herein. Several earlier authors (Foex and Forrer, 1936, Hutchinson and Reekie, 1946 etc) have used electrodynamic balancing with a Curie or other types of balances. Innovation of the present method lies in suspending a single crystal from one arm of a Curie-balance with a fine unspun silk fibre so that its maximum susceptibility direction in the horizontal plane sets along the horizontal magnetic field and the crystal moves bodily along the horizontal gradient at right angles to the field available with a modified Sucksmith type pole-gap of an electromagnet A current bearing coil, rigidly suspended from this arm of the balance, with its axis parallel to the field direction, is placed close to the sample, to compensate the magnetic force on the sample, acting ultimately on the balance arm.

For the sake of robustness of the system, the usual single fragile quartz suspension fibre of the balance beam, has been replaced by a pair of thick phosphor bronze strips above and below the beam which also serve as current leads for the compensating coil. This has made the deflection of the balance beam and hence the displacement of sample in the field advantageously small. For accurate compensation of the force on the sample, the small deflection is highly magnified by a balanced photoelectric cell device. A light spot, reflected from a small mirror attached to the centre of the balance beam, falls equally on a pair of photo electric cells in series, the out-put of which is fed to a sensitive galvanometer, the circuit being adjusted for null deflection. A small deflection of the beam. and hence of the light spot, upsets the balance of the circuit, and a large deflection of the galvanometer is observed The current in the compensating coil, in the magnetic field, is adjusted until the spot comes back exactly to its original position.

The coil current can be very accurately determined by measuring the potential drop across a standard resistance With this type of suspension and an oil damping device, effects of all external disturbances on the system are practically eliminated. The balance assembly is covered with a glass bell-jar and the system can be evacuated or filled with any gas.

The overall error in the measurement at room temperature is estimated to be not more than 0.1%, including any difference in the value due to different samples.

The balance has been standardised. The square of the effective moment (corrected for diamagnetism) p_f^2 for ferric ammonium sulphate alum obtained by us is 34 79 as against 34.80 obtained by Dutta Roy (1955) and 34 79 by Onnes and Oosterhuis (1926), all at 290°K. Taking this value as standard, that of chromium potassium sulphate alum is measured to be 14.89 as against 14 91 by Dutta Roy (1956) and 14 92 by de Haas and Gorter (1929) all at 300°K, and that of $NiSO_4$ $6H_2O$ along its tetragonal axis is found to be 9.701 as against 9 687 by Dutta Roy (1955) and 9.656 by Mookerji (1946), all at 307°K.

The details of the balance will be published shortly

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